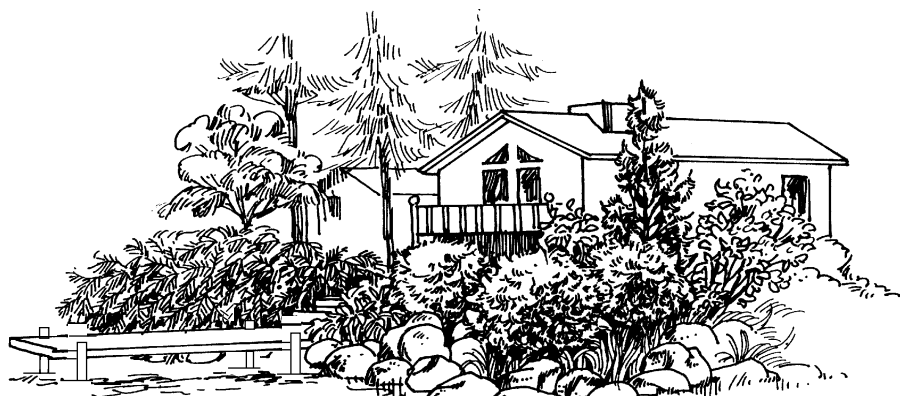


Lakeshore Protection in Indiana



Indiana Department of Natural Resources
Division of Soil Conservation
Lake & River Enhancement Program
402 West Washington Street • Room W-265
Indianapolis, Indiana 46204-2739
(317) 233-3870
www.state.in.us/dnr/soilcons/index.htm

(Revised June 1999)

Life in the water and on shore meet at the lake shoreline. Many young children's earliest memories of a lake are from playing at the waterline—catching tadpoles and learning to swim. Shorelines furnish nursery areas for the young of other species as well, including fish, ducks, turtles, and dragonflies. A properly managed lake-shore will provide benefits to residents above and below the water by:

- protecting the lake shoreline from excessive erosion;
- enhancing the natural beauty and value of lakefront homes; and
- providing food and shelter for fish, birds, and other wildlife.

Improper management practices may increase erosion, degrade fish and wildlife habitat, limit recreational enjoyment, and diminish property values.



LIFE ON THE EDGE

Lake-dwelling fish depend on a diverse mixture of habitats for laying eggs and raising their young, particularly during spring and summer. The tree roots, fallen logs, boulders, and plants that occur naturally along lake shorelines provide places to hide from predators. Without protective cover in shallow water, predators will consume excessive numbers of young fish, leading to a decline in fish stocks. These crevices and plants also support a variety of vital food resources for many species of wading birds, waterfowl, turtles, fish, and other animals which feed on plants, insects, crayfish, snails, and small fish along the shoreline. Some species which live on land periodically use shore zones for feeding or reproduction. Access to drinking water from the shore is necessary for many wildlife species, as well.

CAUSES OF EROSION

Shorelines can erode through many processes. Natural causes of erosion include currents, waves, ice, and rain. Many human activities may significantly increase the rate of erosion. Some common causes include:

- removal of natural vegetation for property development or creation of beaches, both on shore and in the lake;
- improper installation of erosion control structures, such as seawalls;
- increased wave action from watercraft traveling close to the shore;
- dredging, filling, or construction on or near the shoreline;
- trampling of banks by human, animal, or vehicle traffic; and
- inadequate protection against stormwater run-off from roofs, driveways, streets, playing courts, and other developed areas.

Lakeshore Protection in Indiana

Causes of shoreline erosion may differ due to location on the lake, water level changes, and season. Shorelines affected by wind-driven ice and waves will be predisposed to more erosive forces. The shallow water zone along the shoreline may dry out and flood seasonally due to natural or controlled fluctuations in lake levels. Shoreline areas that are dry during some years may provide additional habitat used by several species for spawning and raising young in rainy years. Changes in water levels can undermine poorly designed seawalls. Proper diagnosis of lake conditions is necessary for designing shoreline protection measures while minimizing damage to fish and wildlife habitat.

GENERAL LAKESHORE PROTECTION GUIDELINES

- Preserve the natural shoreline. The natural shape of the lakeshore and the plants existing at and above the water line usually provide excellent erosion control and habitat value.
- Maintain a proper watercraft speed when approaching or passing close to shore. Wakes generated by motorboats and personal watercraft can cause extensive shoreline damage when the waves impact the lakeshore and lake bottom. When passing within 200 feet of shore, a boat must not be operated at a speed greater than 10 miles per hour (IC 14-15-3-17) or greater than a speed which is reasonable and prudent (IC 14-15-3-7).
- Avoid new construction at or near the lakeshore. Moving heavy equipment and clearing land for construction makes soil vulnerable to erosion. Maintain a wide buffer zone of trees and shrubs between any structures and the edge of your lake. Lay mulch, straw or erosion control mats to control erosion during construction.
- Use a temporary or floating dock, rather than a permanent dock. Permanent docks disrupt lake bottom habitat during construction and may cause erosion problems by deflecting underwater currents. All permanent dock construction requires a permit from the Indiana Department of Natural Resources (IDNR). Because of the great potential for environmental harm and for unreasonable interference with public enjoyment of the lake, an application for a permanent dock must undergo a rigorous permit review process.
- Carefully select erosion control methods. Choosing the proper erosion control will save money, time, and maintenance worries.

EROSION CONTROL METHODS

If erosion poses a significant threat to lakeshore property, you will need to select the control method best suited to your needs. The following guidelines include information about the most common construction materials used for controlling erosion:

1) vegetation, 2) bioengineering, 3) stone or riprap, and 4) concrete or sheet piling. These guidelines include information about cost, effectiveness, maintenance requirements, appearance, and impacts on fish and wildlife habitat for each set of materials. In some cases, a combination of methods may constitute the most effective design for protecting the shoreline and providing wildlife habitat.

With any shoreline protection or construction project, a design which does not take your lakeshore conditions into consideration may fail and leave you with a bigger and more expensive erosion problem than originally existed. Shoreline projects require an IDNR permit. Through the permitting process, engineering consultants or agency officials can assist you in determining the best design for your project, and consulting these resources before you start construction will ensure the most time and cost-effective result.

The scale and intensity of shoreline processes on Lake Michigan may require different techniques than smaller, inland lakes. Please seek assistance from the IDNR Lake Michigan Specialist (219) 874-8316 or other qualified professionals.

1. Vegetation

Shoreline vegetation protects property naturally, effectively and inexpensively. Erosion can result where vegetation has been damaged or removed by construction, herbicide application, or wave action. Trees offer excellent erosion control because of their deep roots which bind the soil and their leaves which intercept rain before it impacts and erodes the soil. Lower branches of trees may be trimmed to maintain a view of the lake. Trees and shrubs not only hold soil and nutrients that may otherwise contaminate the lake, but provide an aesthetically pleasing screen to protect the privacy of lakefront property owners. Nearshore water plants protect the shoreline against waves and provide excellent fish habitat.

District IDNR foresters or biologists and many local nurseries or landscape companies can recommend appropriate plant species for use in and near water. Avoid non-native or invasive species such as reed canary grass, European alder, amur honeysuckle, white mulberry, and purple loosestrife. Planting of purple loosestrife is prohibited in Indiana. Native Indiana trees especially well-adapted to the wet soils along lakeshores include black willow, silver maple, sycamore, green ash, and American elm.

2. Bioengineering

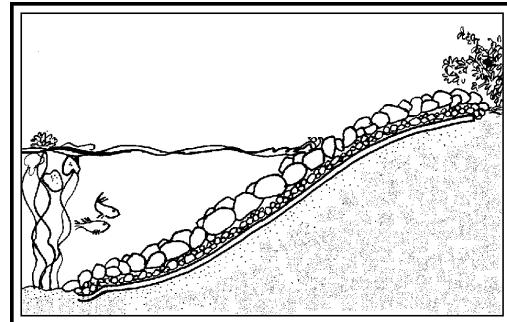
Occasionally, steep bluffs or high wave energy make it difficult to establish or maintain shoreline vegetation. In these circumstances, property owners may need to utilize innovative engineering techniques, such as “bioengineering,” to restore shoreline vegetation.

Common bioengineering techniques include: planting vegetation on slopes stabilized with blankets made of special, biodegradable fibers; transplanting trees into stone or riprap (known as “joint planting”); planting freshly cut willow limbs in the ground (known as “willow staking”); and laying interlocking blocks with gaps designed to promote plant growth.

Bioengineering can cost more than either vegetation or riprap alone. However, bioengineering methods can effectively protect highly vulnerable shorelines less expensively than seawalls or retaining walls. Unlike a solid seawall, bioengineering also maintains the valuable shoreline habitat and increases in strength over time as the plants grow. Because of the complexity of these techniques, the assistance of a professional is usually necessary to attain satisfactory results.

3. Stone or riprap

Large stones placed on top of gravel or a filter blanket will stabilize gradual to moderately-sloped lakeshores by holding soils and dissipating wave action. The size of the stones and width of the stone layer required to effectively protect a shoreline depend on wave height, slope of the shoreline, fetch (extent of open water near the shore), and distance between the high and low water lines. Where underwater beaches reach the shoreline, use of pea gravel (small rounded stones about 1/4 inch diameter) will provide more stability than sand.



Use of large stones also provides a rocky, natural-appearing shoreline with some habitat value, particularly if vegetation grows up through it. Variations in depth along the shoreline provide diverse habitat for different species of plants and animals. Fish, turtles, crayfish, and other animals look for food and protect their eggs and young among vegetation and gaps in the rocks.

Seawalls constructed of naturally occurring field stone or quarried limestone riprap will protect a shoreline effectively and inexpensively in most cases. However, improper installation can cause any structure to fail. Inadequate protection along the base or toe of a stone wall can lead to erosion and slumping of the material. To protect against such

failure, use large stones placed partially into the lake bottom on the lakeward side of the riprap as a buffer against currents and waves. Large ice sheets may roll over the stones, which can cause some rocks to shift and fall. Spring maintenance of stone seawalls involves placing these rocks in their original position.

4. Concrete or sheet piling

Seawalls constructed with an inflexible vertical surface protect shorelines by reflecting wave energy, rather than absorbing it like riprap or vegetation. As a result, such a seawall can worsen wave action on a lake and increase erosion in front of and to the sides of the seawall.

Wave reflection from inflexible seawalls can increase turbidity by stirring the lake bed. Unique and sensitive water plant species, including rushes and other plants necessary for maintaining the fish community, may disappear due to lower water clarity, increased wave action, and scouring of the lake bed.

Near vertical seawalls can permanently degrade shoreline habitat by replacing the naturally, sloping shore zone with a vertical face that cannot be used by plants or animals and eliminates gradual and diverse changes in water depth near shore. Near vertical faces can block access to and from the water for turtles, frogs, and other species that must periodically use underwater areas to feed or reproduce.

Inflexible seawall materials can cost substantially more to install than some other erosion control techniques and may reduce or eliminate vital aquatic habitat. These types of seawalls can require regular maintenance to repair damage from direct wave or ice impact, undercutting by currents or waves, and seepage from the landward side. Due to these constant stresses, seawall strength decreases over time. Common causes of failure include inadequate toe protection, subsidence of backfill soil, build-up of pressure behind the seawall from inadequate drainage or weak anchoring, and direct wave or ice impact exceeding the design specifications of the seawall.

Near vertical seawalls constructed of inflexible materials are best suited to areas with extremely high wave energy, vertical bluffs, at marinas which support intense boat traffic, or in settings where other solutions are not feasible. Negative impacts of a vertical seawall can be lessened by facing the seawall with glacial stone or riprap on the lakeward side.

Stabilizing the toe or refacing an existing vertical seawall with stone or riprap may replace some of the lost habitat value and minimize erosion due to wave reflection.

LOCATING WETLANDS AND SIGNIFICANT SHORELINE VEGETATION

Wetlands provide a natural buffer between land and water at many Indiana lakes and are protected by state and federal law. Appropriate materials for seawalls and other shoreline construction are based on wetland conditions at the proposed project site in three categories: significant wetland, area of special concern, and developed area as defined in 312 IAC 11-2.

A **significant wetland** (312 IAC 11-2-24) is an area where shoreline zones possess at least one of the following qualities:

- 1) at least 2,500 square feet of contiguous emergent vegetation or rooted vegetation with floating leaves;
- 2) unaltered shoreline for at least 250 feet;
- 3) adjacent wetland areas designated by a federal or state agency;
- 4) existence of animals or plants that are listed as extirpated, endangered, threatened, or rare; or
- 5) for which an alteration would result in significant environmental harm.

An **area of special concern** (312 IAC 11-2-2) contains at least one of the following characteristics:

- 1) more than 100 square feet of contiguous emergent vegetation or rooted vegetation with floating leaves;
- 2) unaltered shoreline where bulkhead seawalls are at least 250 feet apart,
- 3) water quality or erosion control benefits;
- 4) bogs, fens, muck flats, sand flats, or marl beaches.

A **developed area** (312 IAC 11-2-7) does not contain any of the following characteristics:

- 1) unaltered shoreline;
- 2) an area of special concern; or
- 3) a significant wetland.

The IDNR has developed wetland reviews for over 100 public freshwater lakes that broadly show shoreline areas designated with these three regulatory categories. These reviews can help developers, local planners and lake managers. Because the reviews are drawn at a large scale, the exact descriptions from 312 IAC 11-2, which are summarized above, should be used for making decisions at a specific site.

Copies of prepared wetland reviews are available from the IDNR Division of Fish and Wildlife by calling (317) 232-4080. These wetland reviews are also posted on the internet at www.state.in.us/nrc/bullet10.htm. Other types of wetland maps may be used for other regulatory and wetland conservation purposes and are available by calling the Soil and Water Conservation District (SWCD) office in your county or the regional U. S. Fish & Wildlife Service office.

INDIANA REGULATIONS

Indiana law states that:

- The natural resources and the natural scenic beauty of Indiana are a public right, and the public of Indiana has a vested right in the preservation, protection, and enjoyment of all the public freshwater lakes of Indiana in their present state, and the use of such waters for recreational purposes (IC 14-26-2).

As defined in the lake rules,

- “Natural resources” means the water, fish, plant life, and minerals in a public fresh water lake.
- “Natural scenic beauty” means the natural conditions as left by nature without man-made additions or alterations.
- “Recreational purpose” means fishing, boating, swimming, the storage of water to maintain water levels, and any other purpose for which lakes are ordinarily used and adapted.
- “Significant environmental harm” (312 IAC 11-2-23) means damage to natural or cultural resources, the individual or cumulative effect of which is found by the director or a delegate to be obvious and measurable (based upon the opinion of a professional qualified to assess the damage) and that:
 - (1) creates a condition where recovery of affected resources is not likely to occur within an acceptable period; and
 - (2) cannot be adequately mitigated through the implementation of a mitigation plan approved by the director.

Therefore, a permit is required from the IDNR for all construction activities at or lakeward of the shoreline of a public freshwater lake, including shoreline protection projects. However, use of vegetation alone for shoreline protection does not require a permit.

Allowable materials for **new seawall** or **seawall reface** construction depend upon the wetland category of the shoreline, as defined in 312 IAC 11-2. The following limitations are in effect under 312 IAC 11-4-2 for new seawalls and 312 IAC 11-4-3 for seawall refaces:

- In a **significant wetland**, the new seawall or seawall reface must be constructed of bioengineered materials.
- In an **area of special concern**, the new seawall or seawall reface must be constructed of bioengineered materials and/or glacial stone.
- In a **developed area**, the new seawall or seawall reface must be comprised of one or a combination of bioengineered materials, glacial stone, riprap, concrete or steel sheet piling.

Lakeshore Protection in Indiana

Other construction materials may be used if the materials, techniques or standards are innovative and are not used in a manner otherwise prohibited by IC 14-26-2, 312 IAC 11-4-2 or 312 IAC 11-4-3. Construction materials **must not** consist of railroad ties, treated timber, broken concrete, tires, scrap metal, appliances, vehicle bodies, or asphalt (312 IAC 11-5-1).

All seawall construction must meet the additional following criteria from 312 IAC 11-4-2 for **new seawalls** or 312 IAC 11-4-3 for **seawall refaces**:

- the location of the lakeward face of the seawall is along the legally established or average normal waterline or shoreline as determined by the department;
- erosion from disturbed areas landward of the waterline or shoreline must be controlled to prevent its transport into the lake;
- an impermeable material must not be placed behind or beneath the seawall or reface materials;
- any permeable filter cloth placed behind or beneath the new seawall or reface materials must be properly anchored;
- the lakeward extent of bioengineered material must be coordinated with the department before filing the license application; and
- the base of glacial stone or riprap must not extend more than four (4) feet lakeward of the **waterline or shoreline** for a new seawall or more than four (4) feet lakeward of the **base of the existing wall** for a seawall reface.

In addition to the conditions stated above, a permit for **refacing** seawalls may be issued if the following conditions are met from 312 IAC 11-4-3:

- the seawall has not been previously refaced;
- if comprised of concrete, the reface must be keyed to the lakeward face of the existing wall and must not extend more than twelve (12) inches lakeward of the existing wall;
- if comprised of steel sheet piling, the reface must not extend more than six (6) inches lakeward of the existing seawall; and
- any walk or structural tie constructed on top of the existing seawall must be located landward of the seawall face.

Applications and additional information are available from the:

IDNR Division of Water, Permit Administration Section
402 West Washington Street, Room W-264
Indianapolis, IN 46204-2739
(317) 232-4160 or in state call toll free (877- WATER55) (877-928-3755)
www.ai.org/dnr/water
(This web address has a searchable database of lake shoreline construction permit applications)

Comparison of Erosion Control Methods

	Estimated cost per lineal foot*	Effectiveness	Maintenance	Appearance	Habitat Value
<u>Vegetation</u>	\$5 to \$20, depending on type and maturity of plants selected.	Excellent at reducing erosion and stabilizing flat or moderate slopes.	Little maintenance required. Varies depending on desired effect.	Preserves natural, scenic beauty of shoreline. Can provide a privacy screen for lake residents.	Reduces soil erosion and nutrient contamination of lake. Excellent habitat for fish and wildlife.
<u>Bioengineering</u>	\$30 to \$100, depending on method selected and severity of erosion.	Excellent at dissipating moderate waves, controlling erosion, and stabilizing most slopes.	If installed properly, requires little maintenance beyond aesthetic management.	Supports natural vegetation and scenic value.	Dampens wave action. Strength and habitat value for fish and wildlife improve over time.
<u>Glacial stone or riprap</u>	\$20 to \$40 for a shoreline with 8 feet between high and low lake levels.	Excellent at dissipating moderate waves and stabilizing slopes up to 2-to-1.	Occasional maintenance necessary to move and replace rocks.	Provides natural- appearing rocky shoreline. Allows native vegetation to grow between stones.	Dampens wave action. Good habitat for fish and wildlife, especially if plant growth is allowed.
<u>Concrete, steel or vinyl piling</u>	\$50 to \$200, depending on type of seawall.	Structural barrier against strong waves and ice. May stabilize bluffs. Increases erosion in lake and along nearby shoreline.	Requires regular maintenance to repair cracks and check for toe erosion. Must be completely replaced or refaced upon breaking.	Permanently alters shoreline contour and prevents establishment of native vegetation along lake shoreline.	Poor habitat value. Increases wave action. Reduces diverse feeding and spawning areas for fish and other aquatic animals.

* These are 1999 figures. Actual costs may vary considerably, depending on local prices, the conditions at your lakeshore, and the level of erosion protection desired.

WHERE TO GO FOR FURTHER INFORMATION**Federal Agencies**

U. S. Army Corps of Engineers—The ACOE can answer questions about federal permits and erosion control techniques.

—Louisville District (Southern and Central Indiana) (502) 582-5607

—Detroit District (Northern Indiana) (313) 226-2218

U. S. Fish and Wildlife Service—The USFWS has technical expertise on lakeshore management techniques with minimal impacts on fish and wildlife habitat.

—Ecological Services Field Office, Southern Indiana (812) 334-4261

—Ecological Services Field Office, Northern Indiana (219) 269-7640

U. S. Natural Resources Conservation Service—The NRCS and SWCD offices provide assistance and technical advice based on their extensive research and experience with soil erosion and water quality.

—Listed under U. S. Department of Agriculture in the local telephone directory.

State Agencies

Indiana Department of Environmental Management—The IDEM can answer questions about the requirements of state water quality permits.

—Toll-Free Environmental Help Line (800) 451-6027 or (317) 232-8603

—Office of Water Management (317) 233-8488

Indiana Department of Natural Resources—The IDNR has regulatory authority for shoreline construction projects on public freshwater lakes and provides technical assistance on lake management. For a searchable database of lake shoreline construction permit applications go to www.state.in.us/dnr/water.

—Division of Water (317) 232-4160

—Division of Fish and Wildlife (317) 232-4080

—Division of Soil Conservation, Lake and River Enhancement Program (317) 233-3870

Local Resource Agencies

Soil and Water Conservation Districts—The SWCDs provide assistance, technical advice, and local leadership on soil erosion and water quality issues.

—Listed under county offices or U. S. Department of Agriculture (NRCS) in the local telephone directory.

Non-Profit Organizations

The Sierra Club Wetlands Project—The Wetlands Project provides technical assistance and educational materials concerning environmental impacts on lakes and wetlands—212 West 10th St., Suite A-335, Indianapolis, IN 46202 (317) 231-1908

Indiana Lakes Management Society—ILMS represents lake management associations and property owners in Indiana—909 W. Maumee, Angola, IN 46703

Tip of the Mitt Watershed Council—The Watershed Council offers technical advice and educational materials for lakeshore and streambank erosion control—P.O. Box 300, Conway, MI 49722 (616) 347-1181

Lakeshore Protection in Indiana

Private Contractors

Private contractors for controlling lakeshore erosion are listed under “Seawalls” or “Erosion Control” in the yellow pages of your telephone directory. Also, look for companies with expertise in bioengineering, vegetation, and/or landscaping.

Literature

Consult the following lakeshore management literature for more comprehensive discussions of erosion control techniques and shoreline management options.

Proceedings of the Workshop on the Role of Vegetation in Stabilization of the Great Lakes Shoreline, Great Lakes Basin Commission, 1977. Ann Arbor, MI.

“Shore Protection: Yes, At a Price,” J. Housley, 1978. Water Spectrum, Summer, pp. 1-9.

Life on the Edge...Owning Waterfront Property. Univ. of Wisconsin-Extension, 1994. Stevens Point, WI.

LakeSmarts, McComas, Steve, 1993. Terrene Institute and United States Environmental Protection Agency, Washington, DC.

“Lakeshore and Streambank Erosion Control,” pamphlet, Tip of the Mitt Watershed Council, October, 1994. Conway, MI.

“Residential Erosion and Sediment Control,” brochure, Urban Land Institute, American Society of Civil Engineers, and National Association of Home Builders, 1978. Washington, DC.

“Streambank Erosion Control Methods,” pamphlet, U. S. Army Corps of Engineers (ACOE), 1980. Washington, DC.

“Help Yourself: A Discussion of Erosion Problems on the Great Lakes and Alternative Methods of Shore Protection,” general information pamphlet, U. S. Army Corps of Engineers, North Central Division, September, 1978. Chicago, IL.

“Regulatory Program: Applicant Information,” Pamphlet EP 1145-2-1, U. S. Army Corps of Engineers, Louisville District, May, 1985. Louisville, KY.

Low Cost Shore Protection: A Report on the Shoreline Erosion Control Demonstration Program (Section 54 Program), U. S. Army Corps of Engineers, The Office of the Chief of Engineers, 1981. Washington, DC.

Biological Impacts of Minor Shoreline Structures on the Coastal Environment: State of the Art Review, Volume 1, FWS/OBS-77/51, U. S. Fish and Wildlife Service (USFWS), March, 1980. U. S. Department of the Interior, Washington, DC

Slope Protection for Dams and Lakeshores, Minnesota Technical Release 2, United States Department of Agriculture, April, 1988. St. Paul, Minnesota.

“Use of Sand or Pea Gravel in Underwater Beach Construction,” pamphlet. Indiana Department of Natural Resources, Division of Soil Conservation, 1996. Indianapolis, IN.

Shoreline Protection Study: A Report to the Wisconsin State Legislature, PUBL-RS-921-96, Wisconsin Department of Natural Resources, June, 1996. Madison, WI.



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